# Red Planet Recycle - Supervisor Meeting - Minutes

# Tuesday 21st February, 14.00

# Classroom 7

## Members Present

Yassen Abbas (YA) Lois Doig (LD) Bo Peng (BP)

Jamie Cassels (JC) Gareth Herron (GH) Charlotte Raymond (CR)

Malcolm Chambers (MC) Sam Jones (SJ) Samuel Walpole (SW)

Scott Clark (SC) Dylan Martin (DM) James Young (JY)

## Supervisors Present

Dr Prashant Valluri

Dr Lev Sarkisov

## Discussion of this week’s progress

### Water Treatment

### Urine Processing Assembly (GH)

* Question was raised as to what kind of evaporator should be used.
* Lev suggests carrying out the Sinnot designs.
  + May be tempting just to change ‘g’ in equations….BUT formulas should be investigated to see if they are applicable to Mars or too deep rooted in an Earth design.
  + Prash suggests investigating Bond numbers to see if surface tension defeats gravity.
  + Prash determines that falling film will be unacceptable due to surface tension being greater than gravity.
* For first approximation, it is fine to just consider the latent heats.
* Biggest problem with evaporator- collecting and driving liquid out. Could use a centrifuge if calculations support the choice.

### Multifiltration Beds (LD)

* Weight of ions removed is used rather than removal of specific ions.
* Justify that this process is needed.
* It is suggested that instead of the mineral bed, a tablet is added to water before it is used to make it potable.
* Composition of tablet will depend on what comes out of the MF bed.

### Catalytic Oxidation Reactor (MC)

* Assumption 1 is deemed to be fine (O2 comp calculated from Henry’s Law).
* Suggested that instead of using an average of all the organic components, design the process around 1 component (e.g. around the least soluble-everything else will be soluble).
* Assumption 3 is fine.
* Assumption 4- dilute systems are mass transfer limited. Other than that, assumption is reasonable.
* It is decided to fix outlet compositions and to optimize elsewhere….
* …asked whether T, P, and flowrates are determined via trial and error; if there is no clear criteria, admit it and give an example design at a chosen set of criteria. Explain why the range of possibilities of these variables exists.
* MC asked if the 1kg of catalyst is reasonable as it appears small.
  + Calculations may be wrong.
  + If not wrong, remember we are not operating on an industrial scale.

### Ion Exchange Bed (YA)

* Number of contaminants entering IEB is unknown. Contradicted by MC assumption that 100% combustion occurs in reactor.
* Sensible assumptions needed. Importance upstream/downstream communication is stressed.
* Tip: a complex process with many organic products can be represented by major components with a specific parameter (e.g. slowest diffusing) and design can be based around this.

### Dehumidification (SJ + SC)

* Total amount of air in station is questioned. Key parameter.
* 25x25x25 (1600m3) is possibly a bit too big.
* Dehumidification technique has to be determined-all the air at once or just the processed air.
* Must consider dimensionless numbers rather than ‘large/small’ quantities.

### O2 Generation - (SW)

* Regarding the grouping of unwanted components, it is vital to check downstream requirements.

### Bubble Column (MC)

* O2 dissolved is proportional to the surface area of the bubble multiplied by its mass transfer coefficient.
* Can relate bubble diameter to its flow speed.
* Regardless of flow, mass transfer coefficient can be determined by Sherwood Number.
* Surface tension vs. gravity has to be considered.

### General Points

* Notation – Decide on constant notation that is confirmed by the editor(s).
* Editors do no technical editing; only proof reading + finalization for Volume I report.
* Try to dismiss designs with basic analogies.
* Communication with upstream/downstream colleagues is of utmost importance.
* Ensure that there are no redundant units-is that particular unit needed??
* Decide on a compromise between removal needs and designing complimenting units.
* There is a concern that sometimes the group tries too hard to mask designs found in papers onto the groups’ numbers. Avoid this.
* Explain ranges and limits in variables that require optimization.
* Beware gut feelings!!
* Stop thinking in terms of ‘too big’ and ‘too small’. The design is not at an industrial level. A lot of the units WILL be small and this is not unreasonable.
* **IMPORTANT-** Ensure sensible assumptions. Cannot have a component as negligible in one stream only for it to reappear downstream. This leads to inconsistent mass balances and questions will be raised. Substances cannot just appear and disappear.
* Does iteration help the design or is there not enough data to do so?
* The nature of a component is irrelevant if it is being completely combusted.
* Consider lumping small molecules into one from which an average molecular weight can be obtained. Then represent this with a ‘fake’ molecule.
* Malcolm- possibly consider designing reactor by the component with the slowest kinetics…everything else will be going faster and the bottleneck will have been identified.
* Outline limiting cases and the range.
* Outline types of information that is needed for a singular design (from a choice of a few).
* Could model on individual elements (C,H,O…)
* Consider toxicity.

## To do as a group

* Create inventory of all species. Determine how multi component mixtures can be represented.
* Confirm mass balances…unaccounted matter is a huge problem.

## Positions Next Week

* Chairman – Dylan Martin
* Secretary – Bo Peng
* Editors- Charlotte Raymond and Samuel Walpole